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A comparison of neighbourhood liveability as perceived by two groups of residents: Tehran, Iran and Tartu, Estonia

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Highlights

- We make a transition from the expert application of liveability indicators.
- We test their applicability for neighbourhood liveability evaluation by residents.
- Similarities in environmental preferences are found between citizens of Tartu and Tehran.
- The neighbourhood liveability is influenced by attributes of residential neighbourhoods.

Abstract

Liveability is an important component of the sustainable urban environment, especially in residential neighbourhoods. This study presents a comparison in perceived liveability between residents living in two very different locations, Tehran, Iran and Tartu, Estonia, using a

questionnaire survey (n = 102). The image-questionnaire was used to measure residents' response towards environmental factors and to examine the relationships between the attributes of residential neighbourhoods and perceived liveability. Statistical analyses were performed to analyze the data collected from the survey. The results showed that the neighbourhood liveability was positively influenced by proportion and scale of the spaces, amount of private green areas, street character, amount of public greenery, the variety of building form, the mix of buildings from different periods, perceived crowding and social density. The study demonstrated that residents can assess the factors and that the approach worked in two contrasting locations. The results also showed a great deal of similarity in preference, although this was not the main aim of the study. The approach has potential to be incorporated into participatory urban planning models.

Keywords: Physical characteristics; Liveability; Neighbourhood; Residents' preferences

1. Introduction

1.1. Liveability

The concept of liveability is in part related to the environmental characteristics of a residential area from a human perspective. Liveability theory assumes that perceived quality of life is, to a large extent, dependent on objective qualities of the environments in which humans live (Antognelli & Vizzari, 2016; Wheeler, 2013; Hankins & Powers, 2009; van Kamp et al., 2003). Liveability is dependent on the affordances of a range of aspects of an area with respect to the needs and capacities of the residents living in the neighbourhood who should, therefore, be involved in its assessment. Norouzian-Maleki et al. (2015) have argued the importance of identifying environmental attributes and using these as criteria which could be applied by experts as indicators of liveability but these criteria ultimately need to be tested for validity with urban residents themselves.

Dimensions of liveability operate at multiple interconnected spatial scales and functional forms (Andersson, 2006). Urban environments vary considerably in terms of the urban form, geographical and climatic conditions, types and amount of green elements, built form and use of materials, among others. Studies on residential liveability indicate that while various housing, neighbourhood and household characteristics determine the level of residential liveability, the impacts of these criteria as determinants of residential liveability tend to vary by housing types, land use mixes (Aurand, 2010; Song & Knaap, 2004), city block sizes, walkability (Brown et al., 2009; Guo et al., 2017), control (Lynch, 1981), identity and cultural and religious traditions; such a complex range tends to indicate that case specific studies are required to determine residential liveability to guide public policies. They also vary according to the region's social context (Balsas, 2004), political trends (Kaal, 2011; Teo, 2014), national lifestyles and the degree to which it is possible to live out of doors for much of the time. Therefore, while the main domains of the criteria as defined by experts may remain consistent, how these affect liveability as experienced by citizens of a particular city and what are the relative contributions made by each domain remain relatively unexplored. Lynch (1981) explained the intersection of human

purposeful activity and city form. He developed five "performance dimensions" and two "meta-criteria". The dimensions are: vitality, sense, fit, access, and control. Efficiency and justice are the two meta-criteria which operate on all the other five dimensions. Little research has been conducted in the area of liveability criteria and residents' preferences across diverse cultures. Perceptions of the residential environment have a direct and independent effect on neighbourhood liveability.

In order to support liveable neighbourhoods, people's subjective perception and interpretation of their own residential environments should be investigated. Previous research has addressed people's perceptions of the quality of their environment in general (Bruch & Mare, 2006; Oku & Fukamachi, 2006; Ribe, 2005). Chon (2004) highlighted the fact that users can be asked for their degree of preference for the elements that comprise the environment in different districts of their cities. Residential preferences and choices have been approached in a non-dynamic fashion yet preferences regarding the residential environment change over time (Schwanen & Mokhtarian, 2004). Visual preference is often the main focus, with less weight given to senses other than sight (sound, smell, touch). Visual preference, a commonly studied attribute (Daniel, 2001; Dramstad et al., 2006; Fry et al., 2009; Lothian, 1999), refers to the degree to which an individual likes or dislikes the visual appearance of one place compared to another and may involved many interacting variables. A comprehensive environmental assessment allows perceptions at individual and community scales to be analyzed and processed as part of comparative information (Cooper et al., 2013; Jessel, 2006; Sullivan & Lovell, 2006).

1.2. Environmental preference

The major factors affecting environmental preference are: 1) physical features - the variation of aspects like the form, height and width of buildings or streets; 2) vegetation and other biological components of the environment such as the presence of trees of different character or species; and 3) the human interest factor - how the environment affects people (Cheng, 2007). In other words, people show different preferences for certain phenomena present in the environment. The aim of phenomenology is to clarify human situations, events, meanings, and experiences as they are known in everyday life but typically unnoticed beneath the level of conscious awareness (Relph, 1996; Seamon, 2000). Therefore, environmental preference is the joint effect of specific features of the environmment interacting with relevant psychological (perceptual, cognitive and emotional) processes in the human observer (Brown & Daniel, 1987; Zube, 1974).

Environmental preference research has generally concentrated on natural or rural environments (Ode & Miller, 2011) and there is much less research on urban environmental preferences. Methodologically, photographs have traditionally dominated preference studies; with the advent of photo-manipulation software it has become routine to modify photographs to obtain experimental control of specific variables. It is also possible to obtain significant outcomes even if the differences between the environmental stimuli are small, for example when a simulated environment is used to study the effect of changing a specific element while keeping everything else constant. The validity of using different simulation techniques for environmental research has been widely discussed (Mahdjoubi and Wiltshire, 2001; Palmer & Hoffman, 2001; Pitt & Nassauer, 1992; Rohrmann & Bishop, 2002; Stamps, 2007). Computer-based environmental

simulations are preferred by many researchers (Reips, 2002). Several studies have also confirmed a concordance in assessment between photographs and other types of image such as computer generated 3D models (Sevenant & Antrop, 2011). Ode et al. (2009) revealed that visualizations (by computer or hand drawn sketches) could be seen as advantageous compared to the traditional use of photographs. Visualization enables absolute control over scene content (for instance excluding features that could be familiar or have a cultural significance to a particular group and keeping lighting and ground texture constant across scenes). It is important to keep the scenes reasonably realistic and close to something that the respondents can relate to.

Several methods have been proposed to measure preferences for urban spaces. The expert paradigm assumes that professionals can analyze environments and translate physical elements into a descriptive assessment of environmental preference (Borst et al., 2008; Herzog, 1992; Lindal & Hartig, 2015). The psychophysical paradigm holds that the environment is a source of stimuli that elicits a human aesthetic response. The psychological paradigm assumes that environmental quality is constructed in the human mind from visual information gathering. This approach emphasizes the cognitive and affective reactions elicited by environments (Daniel & Vining, 1983; Maulan et al., 2006). The experiential paradigm focuses on the experience or phenomenon of human environment interaction (Golledge, 1997). Experiential research assumes that aesthetic quality comes from both environments themselves and also from the meaning that people attach to them (Dzhambov & Dimitrova, 2015). An individual's response to his/her environment consists of three components: the physiological response, an affective appraisal/emotional reaction, and a behaviour change, with the aesthetic response occuring at the intersection of the three (Nasar, 1997).

The effects of cultural differences have been considered to be an important factor in environmental preference (Herzog et al., 2000; Wong & Domroes, 2005; Kaymaz, 2012). Knox and Marston (2003) have pointed out that different cultural identities influence the ways in which people experience and understand their environemnts. Cultural influence in people's preference is likely to appear in specific environments that contain certain cultural meanings (Hull & Reveli, 1989). People may live in very different social structures which can be reflected in house design and urban patterns. For example, individualism in some western countries has led to small family sizes and numerous households for small nuclear families, single-parent families and widowed older people while in other cultures multiple generations and extended families may inhabit a single residential compound. Houses may be open to the street, with windows looking outwards, or streets may be dominated by inward-looking houses with high windowless walls and stout doors.

1.3. Study objectives

The objective for the study reported here was to make a transition from the expert application of selected indicators obtained from previous research (Norouzian-Maleki et al., 2015) and to test their applicability for neighbourhood liveability evaluation by residents of two cities in two countries with widely contrasting environmental and cultural conditions. It was hypothesised that while the domains of the criteria may remain effective, the preferences for different ranges of values within each domain would be different, reflecting the variation between the two settings.

Using two places with strong contrast should be an effective way of testing the scales of variation. The research questions is therefore: is it possible to develop a reliable model for assessing neighbourhood liveability that works regardless of urban conditions and cultural context?

2. Methodology

2.1. Case study selection

We examined the environmental preference of residents from two different countries, Iran and Estonia, which were chosen for their contrasts in climate, urban density, built form and quantity of urban green areas well as their cultural conditions. Tehran, the capital of Iran, is a large city in a semi-desert Middle-Eastern country with a hot dry summer and mild winter (Nasrollahi, 2009). The population density of Tehran is 11,596 persons per km². It is a muslim country with strong cultural traditions embedded in its urban form and fabric, although with more recent modern trends in architecture and traffic-filled roads significantly affecting the city. Tartu is a small city in a northern European country with mild, moist summers and cold snowy winters. The population density of Tartu is around 2,492 people per km². It has built form from several eras including an 18th century town centre, 19th and early 20th century low-density wooden housing, Soviet era multi-story blocks of flats and more modern apartment buildings (PHC, 2011). It is also a very green city both in terms of public green areas and private gardens.

The approach adopted in the research was to apply liveability criteria based on the framework developed by Norouzian-Maleki et al. (2015) by testing them on residents in the two cities. These criteria can play a role in the evaluation of liveability and at the same time have significant practical implications for urban planning. In the previous work, a Delphi study was used to explore experts' opinions about the factors or criteria affecting liveability in the two case study areas, thus making the basis for evaluating liveability more operational when measuring it together with assessments by residents.

2.2. Experimental design

We chosen a design which presented survey respondents with a series of urban views containing ranges of different environment parameters conforming to the criteria from the Norouzian-Maleki et al. (2015) expert study cited above. A paper-based survey was used to record participants' responses. Participants selected their preferred image from sets of sketches; they had no previous experience of the views depicted, which were not specifically associated with either city, so that clearer comparison could be made.

Sketches of urban scenes were prepared in an effort to represent places as they might be experienced by residents. Seven criteria were tested and variations of each scene were prepared, 33 sketches in total. The neighbourhood descriptors included: proportion and scale of urban spaces, amount of private (but visible) green areas, street character, amount of public greenery, variety of building form, mix of buildings from different periods and number of people using the public space. The original sketches produced using ink and colour wash were digitized at a high resolution to ensure clear, sharp images when printed.

The review of the literature on observer-based visual impact assessment methods (Feimer et al., 1981; Smardon, 2016) revealed considerable variation in three facets which need to be addressed in an experimental design: (1) the descriptive environmental attributes which serve as the basis of ratings; (2) the rating procedure adopted, including instructions for attending to the environmental representation and recording responses; and (3) the form of simulation employed to depict changes in the neighbourhood. We took these aspects into account when developing the questionnaire. In our study we presented the images in a consistent way with clear differences between the variants in each set; the rating was a simple ranking of all options from most to least preferred; and the simulation sketch style was such that it could not be mistaken for reality and did not contain extraneous information so that control over the variables was absolute. In order to extract quantitative data about the variability of the factors across the images in each set, for example the amount of vegetation depicted as a proportion of the scene, each picture was overlaid with a 200-cell grid and the number of grid cells containing each of the descriptors of physical characteristics were counted and expressed as a percentage of the total number of cells for each picture.

2.3. Response Format

Preference was measured using a comparison in which residents evaluated a group of scenes based on a standard value and expressed their ranked preference in terms of how relatively liveable they considered each scene to be. The magnitude estimation approach can be a very powerful way of measuring scenic quality (Brunson & Shelby, 1992; Palmer, 2004; Zube, 1974). However, this requires scenes to be sorted and manipulated on a large response board. Key revisions to the method adopted here were: (1) the use of two groups of participants, from different countries; (2) the use of colour pictures; and (3) the use of an additional pilot study to refine the attributes before adopting the final full-scale study. Pilot testing also helped to ensure that the survey was comprehensible and that it did not take too long to complete.

An English language version of the questionnaire was first prepared and explanations were given by the surveyors in the residents' language. However, Persian and Estonian translations were also available to respondents. In total 204 respondents (102 Tehran residents and 102 Tartu residents) participated in the study. The selection of the respondents was based on the stratified systematic sampling method (Barnett, 2002; Irga et al., 2017; Jiboye, 2014). Relatively more of the participants were female than were male. Stamps (1996) indicated that 40 respondents and 20 pictures would be required for a satisfactory effect size of 0.01 at α=0.05, so, the sample size in this study, which had 204 respondents and 33 pictures (Figs. 1-7) can be considered to be somewhat above this minimum. The respondents from each country were asked to rank the pictures from the most to the least preferred, thus establishing an ordinal scale of preferences that measured differences among the simulated scenes, as indicated by analysis of variance tests.

2.4. Data collection and analysis procedure

This research was mainly based upon Europeans and Asians. The participants were selected from three lower-density neighbourhoods in each of the two cities, Tehran (Iran) and Tartu (Estonia). These subjects were usually educated urban residents. Spatially, the structural layout consisted of

three- or four-storey houses within regular roads including cul-de-sacs. Instructions were supplied for each section. Each scene for each question was shown separately in order to reduce the chance of interrelationships between picture ratings. The preference question was the easiest question for residents to answer and was related to the level of perceived liveability.

The data from the questionnaire were analysed using the SPSS version 22.0 for Windows. Since the research used responses instead of persons as units of analysis, the alpha level of 0.05 was adopted to reduce the chance of making type I error (Larson & Delespaul, 1992). Analysis of variance (ANOVA) was used to compare the differences between different respondent groups. Such specific differences are not revealed solely through correlation analysis (Kaplan and Herbert, 1987; Yu, 1995). Homogeneity of variance was checked using a Levene's test. Cronbach's alpha test was carried out in order to calculate the lower bound for the true reliability of the survey (a function of the number of test items and the mean inter-correlation among the items). The alpha of these constructs ranges from 0.89 to 0.95, indicating a good level of reliability.

3. Results

The results are presented according to the order of the questions in the survey. There are clearly differences among the two country's respondents; however, the Pearson correlations indicate that there is also substantial overall agreement in the relative value of the scenes. We also show the images used in the questionnaire in order to provide context when interpetating the results. Owing to the sample size the comparison uses all respondents together; no breakdown by e.g. age or gender was undertaken.

3.1. Effect of proportion and scale of the street space

The participants rated six models of environments on criteria of proportion, scale and degree of enclosure. Environments varied in aspect ratio (width/height) but had the same horizontal scale. Figure 1 shows the views used for this question.

Fig. 1 about here

A summary of the finding for this variable is shown in Table 1. Tartu respondents mainly preferred images A2 (Mean= 0.28), and A3 (Mean= 0.22), and to some extent A4 (Mean= 0.12), which show the low or medium rise buildings in the 1:1 or 1:1.5 proportion typical of much of Tartu but they did not prefer A1, the 2:1 proportion (where the houses are single storey – not common in Estonia) nor A5 or A6 (which show higher buildings, more redolent of the Soviet era housing).

The Tehran respondents gave somewhat similar but slightly different scores: the highest preference was for A3 (M= 0.50), followed by A2 (M= 0.26) and A4 (M= 0.10) while the lowest scores belonged to A6, A1 and A5. The main preference for spaces with ratio 1:1.5 was stronger than in Tartu and the preferences here reflect more the typical situation in Tehran.

A Mann–Whitney U test was used to compare the results for the two groups. Differences between groups were found statistically significant at $p < 0.05$. There were statistically

significant differences between the Tartu and Tehran residents and their ratings of several scenes: “A1- Proportion 2:1” (U = 915.00, Z = -2.596, p = .009), “A3- Proportion 1:1.5”, (U = 937.50, Z = -2.495, p = .013), “A5- Proportion 1:2.5” (U = 1017.00, Z = -2.521, p = .012), and “A6- Proportion 1:3” (U = 875.00, Z = -3.015, p = .003).

Table 1 about here

3.2. Effect of vegetation on private property within a scene

Respondents were shown six images of different proportions of vegetation within the private territory of a house. Table 2 shows the distribution of the scores for each scene. According to the Tartu respondents, scene B6 which shows the house set amongs tall trees and shrubs scored the highest (Mean = 0.30) followed by scene B4 (Mean = 0.22) and B3 (Mean = 0.16) with lower proportions of green. Scene B1 (Mean = -0.78), scene B2 (Mean = 0.02) and scene B5 (Mean = 0.08) received the lowest scores respectively. Why B5 scored lower is a mystery as it is quite similar to B6.

For the Tehran respondents, scene B6 was also ranked first followed by B5 (M = 0.26), B4 (M = 0.14), B3 (M = 0.08) , B2 (M = -0.20) and B1 (M = -0.64) - on other words in descending order or amount of greenery.

Fig. 2 about here

The ratings clearly show that the greatest preferences were for scene B6 with the greatest amount of greenery by both groups of residents, then the preferences reduced in generally descending order. The Mann-Whitney U Test shows that the differences in preferences between the two groups of respondents are only significant for the scenes B2 (U = 980.00, Z = −3.432, p = .001) and B5 (U = 1025.00, Z = -2.384, p = .017) where the Tartu ranking order was different.

Table 2 about here

Preference was therefore highest for images of which more than 40% of the scene is covered with vegetation, especially taller trees. When less than 10% is covered by vegetation it is least preferred. It appears that respondents in both cities perceived that vegetation in the foreground scene contributes significantly to their liveability. This reflects the general current situation in Tartu which is a green city but perhaps reflects more what people would like to see in Tehran which is a lot less green.

3.3. Effect of street scale and character

A set of sketches showing different street configurations – width, degree of pedestrianisation versus cars and different amounts of street trees. The mean preference value for each scene is shown in Table 3 for each of the two countries. Both sets of respondents preferred a six-lane boulevard with on-street parallel parking and three parallel lines of tall street trees (variant C6). According to the Tartu respondents, preferences were quite varied; the most preferred scene stood out as C6 (mean value of 0.44). C3, with several lanes of traffic and no median (mean of -

0.32) and C5 with a wide median (mean of -0.18) received the lowest scores, whereas C1, pedestrianized, received approximately the same score as C4 with fewer lanes than C3 but these were smaller degrees of preference when compared with the overall strong preference for C6.

Fig. 3 about here

Tehran respondents also perceived C6 to be the most preferred environment, slightly more so than for the Tartu respondents (mean value of 0.46) followed by C4 (mean of 0.32) and C5 (mean of 0.14) – these mostly similar but either narrower or with less parking than C6. On the other end of the range, C3 (mean of -0.42) and C1 (mean of -0.36) were identified as the two least preferred environments, the same as for Tartu, although more strongly so (Table 3).

The results of the Mann–Whitney U Test show statistically significant differences for the scenes C4 ($U = 984.50$, $Z = -2.091$, $p = .037$), C5 ($U = 895.50$, $Z = -3.237$, $p = .001$) and C1 ($U = 797.00$, $Z = -3.847$, $p < .001$), the Tartu residents being more likely to assess this environment as preferred.

Table 3 about here

The findings show that people have a certain tolerance for traffic congestion. A six-lane boulevard with on-street parallel parking therefore appears to generate the highest preferences. Although the images improve the visual appearance of the neighbourhood environment by including several rows of trees they are not high-priority when choosing where to live compared with some other factors. Some of the responses, preferring e.g. Option C1 suggest that traffic can diminish the overall appearance of the street for some people. Worsening traffic congestion has negative effects on the neighbourhood liveability. Traffic congestion not only increases air and noise pollution but also increases the hazards of crossing the streets by pedestrians.

3.4. Effect of public greenery and vegetation

Vegetation has been widely recognized as an efficacious factor in the neighbourhood liveability. This variable considers green elements in the public space as opposed to the private space in Variable 2. Four alternatives were offered (Figure 4). Table 4 shows the mean differences in scoring between the two respondent groups. The most striking observation is that for the scene D1, both Tartu and Tehran respondents gave similar preference scores.

Fig. 4 about here

The highest preferences by Tartu respondents were given to scene D3 (M = 0.54) followed by D2 (M = 0.20) – both with considerable amounts of greenery, while the lowest ratings are given scene D1 (M = -0.66) with no public greenery and also D4 (M = -0.08) with the greatest amount. The findings showed that if vegetation occupies a proportionally large sector of the scene, it may have a somewhat negative effect on environmental preference ratings. According to the Tehran respondents, D4 (mean of 0.42) and D3 (mean of 0.30) were most preferred – the greenest scenes of all. D1 (mean of -0.74) and D2 (mean of 0.02) received the lowest scores – a clearer picture of descending order of preference.

According to the Mann-Whitney U test, for 3 out of the 4 scenes there is a significant difference in the mean score between two groups; D2 (U = 1030.00, Z = -2.101, p = .036), D3 (U = 950.00, Z = -2.419, p = .016) and D4 (U = 819.50, Z = −3.174, p = .002). The results show that a majority of both residents wanted more greenery in their own residential environments, although preference declines after the amount of public greenery exceeds a certain point (40.00% and more) for the Tartu respondents.

Table 4 about here

3.5. Effect of building form

Man-made structures are considered as one of the main determinants of environmental preference level. Four alternatives of building form were presented to the respondents. These all tend to have some contemporary architectural features but show differences in spatial articulation and overall proportion (Figure 5). The results are summarised in Table 5.

The preferences of Tartu respondents was for scene E4 (mean of 0.66), which indicates that residents perceived this scene as the most preferred environment. The next most preferred option with a mean score of 0.20 is scene E3 followed by E1 (mean of -0.52) and E2 (mean of -0.34) as the least preferred environments for residents. E4 shows a lower rise area with a larger public space and a big tree, which may account for the preference. E3 also has less dominating buildings while E2 has the biggest most dominating buildings of the four options. E4 is possibly most like a Tartu scene and so is most familiar to those respondents.

Fig. 5 about here

The Tehran respondents also perceived scene E4 to be the most preferred environment (mean of 0.30) followed by E3 (mean of 0.26) and E2 (mean of 0.04). Scene E1 (mean of -0.60) was identified as the least preferred environment.

The results of the Mann-Whitney U Test show statistically significant differences for the scenes E4 (U = 899.00, Z = -2.743, p = .006) and E2 (U = 878.50, Z = -2.903, p = .004) between Tartu and Tehran.

Table 5 about here

When considered the scenes received the highest scores, it was seen that their common characteristics were their form diversity, which prevented monotony and caused them to be harmoniously more elaborated and attractive. The results showed that there is a positive relationship between harmony and scene score. However, there is also a large tree in scene E4 which could also have added to the effect. Indeed, natural elements are almost reported to be more attractive than environments containing man-made structures.

3.6. Effect of contribution of buildings of different periods

Respondents were offered three options for scenes with ranges of buildings in styles clearly of different historical eras (Figure 6). None are specifically of Tartu or Tehran, being rather anonymous to avoid clear cultural preferences.

Interestingly, one of the few major differences between the two groups concerned their preference this variable as summarized in Table 6. From the Tehran respondents' viewpoint, the scene F2 (mean of 0.26) was most preferred. Scenes F3 (mean of -0.16) and F1 (mean of -0.10) received very similar low scores. Tartu respondents perceive F1 (mean of 0.22) to be the most preferred environment followed by F3 (mean of 0.14) and then F2 (mean of -0.36). It seems that the residents of Tehran were more attracted to mixed modern and traditional buildings than the residents of Tartu were, although it may be the spatial quality that affected Tartu preferences, since this scale are perhaps more identifiable to residents of Tartu.

Fig. 6 about here

The results of the Mann–Whitney U Test show statistically significant difference for the scene F2 ($U = 972.50$, $Z = -2.031$, $p = .042$). Also, there were a significant difference in preferences for the scenes F1 and F3 between two groups, at the level of significance 0.05 (Table 6).

Table 6 about here

3.7. Effect of number of people using the public space

Respondents rated scenes on the criterion of crowding for social densities of environments. They were presented with four images of the same scene – a large modern development with outdoor space occupied by different numbers of people (Figure 7). Social density, the number of people using the public space, ranged from 1.5 to 6 m^2/person.

The Tartu respondents preferred G1 (mean of 0.48) and G2 (mean of 0.26) with the lowest preferences for G4 (mean of -0.90) and G3 (mean of 0.16). For the Tehran residents, scene G2 was most preferred (mean of 0.34) followed by G3 (mean of 0.18), G1 (mean of 0.04) and G4 (mean of -0.56).

Fig. 7 about here

The ranking show that the lowest scores were given to scene G4 by both groups of residents. It is suggested that the higher social density environment was rated as being more crowded and potentially less comfortable than the lower social density space. These differences in preferences are significant for the scenes G4 ($U = 937.50$, $Z = -2.986$, $p = .003$) and G1 ($U = 899.00$, $Z = -2.622$, $p = .009$) (Table 7). Tartu respondents mainly preferred the scenes with lower social density – reflecting their experience of a small city with much less crowding in general, compared to Tehran respondents being more used to busier public spaces.

Table 7 about here

4. Discussion

Over recent decades there has been increasing interest in assessing environmental quality and sustainability of residential neighbourhoods. In order to understand the importance of different variables, investigating how people react to different characteristics of the environment is required. Environmental assessment studies concentrate on evaluating the physical characteristics and social life of a place on a perceptual basis within a functional relationship. The preference study reported here has tried to determine not only what people do and do not prefer, but also to understand the perceptual patterns that derive from their experiences associated with preferences. Physical characteristics were altered using simulations for the assessment. The preceding analysis has shown that there were some clear patterns of preference emerging from the image ratings and that significant differences were visible between the two respondent groups in certain cases more than others.

Preference ratings has been shown to vary by cultural background and long-term environmental experience (Gentin, 2011). This cross-cultural study was initiated in order to investigate whether respondents of different nationalities were likely to prefer similar or different attributes of places in terms of liveability as a means of testing the universality of the criteria determined previously (Norouzian-Maleki et al., 2015). Examination of the mean preference rankings indicates substantial variation between the rankings of respondents in both countries for some variables more than others while at the same time the most preferred scenes tended to be the same (except in one instance). The most preferred scenes are favoured for a wide variety of reasons according to the participants' grouping, cutting across many categories describing the residential environment. Generally, the results of this limited survey show that despite cultural differences, people seem to have similar preferences for specific environments. A multinational evaluation of such scenes would help to understand cross-cultural variation in ideal or preferred environments, as well as undesirable environments much more thoroughly. The results showed a relationship between the neighbourhood liveability and the physical components of proportion, amount of greenery and vegetation, street character, buildings form, and amount of street use.

The overall pattern of these ratings can be seen in Figure 8, which plots the mean preferences for each of the two countries for each of the variables. There are some stand out positive preference patterns but also the least preferred options are often more significant, such as when a space is too crowded, when there is no greenery at all in either private or public spaces or the building form is to massed and dominating.

What do these results mean for planning and design? The results suggested that neighbourhood liveability can be affected by the proportion and scale of the spaces with the overall proportions of 1:1 and 1:1.5 width to height ratios found to be the most preferred. This result could be used when developing building codes to ensure that the feeling of scale, proportion and enclosure are kept in balance. It is already the case in some places that the building height proportionate to street width (Mills, 2008; Schulte et al., 2015) is a factor in planning and this could be extended. Planners in hotter climates such as Tehran might, however, consider the shading cast by taller buildings (not considered here) as something else to add in this ratio calculation.

Significant amounts of greenery (40% plus) in both public and private spaces stood out in both locations as being as a good indicator of the relative level of liveability found in a neighbourhood. The level of naturalness of neighbourhood green spaces serves as an important component for promoting the psychological well-being of residents (Marselle et al., 2016).

The variability in the environmental preferences of the respondents assessing scenes of neighbourhoods affected by private greenery was significantly influenced by the presence of trees and shrubs in the depicted scenes, as well as public greenery and vegetation. In Tartu there is plenty of green space and vegetation in residential neighbourhoods, while in Tehran there is not so much, so it is interesting that while this result may have been expected in Tartu it would not be so in Tehran. Private gardens around houses in Estonia are also more common. This result is in accordance with other studies (White et al., 2013; Ambrey & Fleming, 2014).

Reduced vehicle prominence produces more preferred urban environments although the results for the street character and the mix of traffic and predestrians were the least predictable or comparable. Tartu respondents ranked the less-busy street more highly while the Tehran respondents preferred (or perhaps tolerated) busier streets. This may reflect the fact that generally, apart from in summer, there is less street life in Tartu than in Tehran and that traffic is commonly lighter but also that Tehran is a denser city overall, traffic is rather dense and that people are more comfortable in a busy neighbourhood. However, some significant differences were found between groups, so the results are not so clear-cut as for other variables.

We investigated whether the form of the buildings influenced impressions of liveability. The results could have been affected by the presence of a large tree in the most preferred scene so that it may not have been the architecture but the sense of green which affected this. Yu (1995) also reported that environments containing natural environments are inevitably more scenic than man-made structures. Thus there is some doubt about the validity of this result and the experiment would need to be more carefully devised if repeated. The contribution made by buildings of different periods was found to influence neighbourhood liveability significantly and positively. All three contribution of buildings of different periods scenes were significantly different. Well-maintained modern buildings were more preferred than mixes of old and new and this was particularly true for mixed buildings with visually rich and highly articulated facades. The perceived crowding and variation in social density (1.5 m^2 per person vs. 6 m^2 per person) showed some interesting differences. The results showed that a residential environment with a low level of density is more likely to be preferred over a residential environment with high density. There is a mix of land uses and densities that would optimize the preferences of both groups of residents.

Fig. 8 about here

Analysis of residents' grouping of these preferred scenes provides insights into their overall perceptions of neighbourhoods. The findings suggest that the feeling of liveability associated with a place can be predicted to some extent by how they perceive the physical environment. The use of sketch visualisations has been found by other researchers to work well as a substitute for

photographs and as a good medium to increase people's awareness and willingness to engage in relation to setting change processes (Fry et al., 2009; Miller, 2009; Smardon, 2016). The control of variables used in our study has generally worked well and the sketches contain measurable attributes. Socio/cultural differences tend to affect the influence of man-made structures on environmental preference. Some findings seem to propose that environmental perception and preference vary from culture to culture. Indeed, cultural belief systems shape individuals' perceptions and responses to environmental preferences. Zube and Pitt (1981) suggested that there is reason to believe that different value systems may prevail across culture. Specific cross-cultural studies have examined differences and similarities in the areas of environmental perception and predictors of environmental behaviours. These have included examinations of psychological distance (Carmi & Arnon, 2014; Gifford et al., 2009; Milfont & Schultz, 2016), values (De Groot & Steg, 2007; Boer & Fischer, 2013), normative social influence (Smith et al., 2012), and emotions (Onwezen et al., 2014). More research examining human–environment interactions is thus needed to pay close attention to cultural aspects. Similarities are also found between different cultural groups. Similarities in environmental preferences between citizens of Tartu and Tehran were not negligible and it seems that many environmental preferences may be more common across cultures than previously thought.

Physical appearance plays a significant role in people's preference for a place and use of the place. Also, liking a place is associated with its social and emotional affordances (Clark & Uzzell, 2006; Norouzian-Maleki et al., 2015). Obviously, designers can provide a greener and less congested street for their residents. They are trying to make neighbourhood spaces less dominated by cars. The proportion and scale of the space, street character, amounts of public and private greenery, and density of people using a space are the characteristics to be considered related to neighbourhood liveability.

5. Conclusion

The research question in this study was: is it possible to develop a reliable model for assessing neighbourhood liveability that works regardless of urban conditions and cultural context? From the results and statistical analysis we can see that it does appear to be possible – there was good reliability and every possibility that with further studies in a larger number of different urban neighbourhoods this could be further validated. The fact that Tartu and Tehran are very different in all respects yet the results were similar in most domains and that in most the scoring showed clear patterns shows that this is a promising field. We were not so interested in the specific preferences of each location – interesting as these were – as much as the test of the approach.

The results of this study are consistent with Lindquist and colleagues (2016) that relying solely on visual representations of neighbourhoods for design, planning and assessment does not sufficiently simulate our experience of the environment. If we investigate various cultural factors in the context of one uniform set of environmental stimuli, more valid assessments can be made

and a more complete representation envisioned. An environmental preference assessment is promising tool to inform and to guide decision makers in their future planning since it has the potential to allow the integration of local perception towards the surrounding and creating a liveable environment, perhaps as part of a participatory planning model. This could be operationalised by asking residents about their main preferences and then translating them into sketched alternatives for a further, broader study and the results fed into the planning process. Pragmatic planning and design implications extracted from the analysis can be considered as a step toward an evidence-based design approach, linking research findings with design solutions (Hadavi et al., 2015). Designers can contribute to the design research by developing new methodologies in order to emphasize their role in creating liveable and high quality environments.

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Fig. 1. The sketches showing the different aspect ratio used in the study (A1- Proportion 2:1; A2- Proportion 1:1; A3- Proportion 1:1.5; A4- Proportion 1:2; A5- Proportion 1:2.5; A6- Proportion 1:3).

Fig. 2. The sketches showing the different amount of private greenery and vegetation used in the study (B1- No greenery; B2- 0.01-9.99%; B3- 10.00-19.99%; B4- 20.00-29.99%; B5- 30.00-39.99%; B6- 40.00% and more).

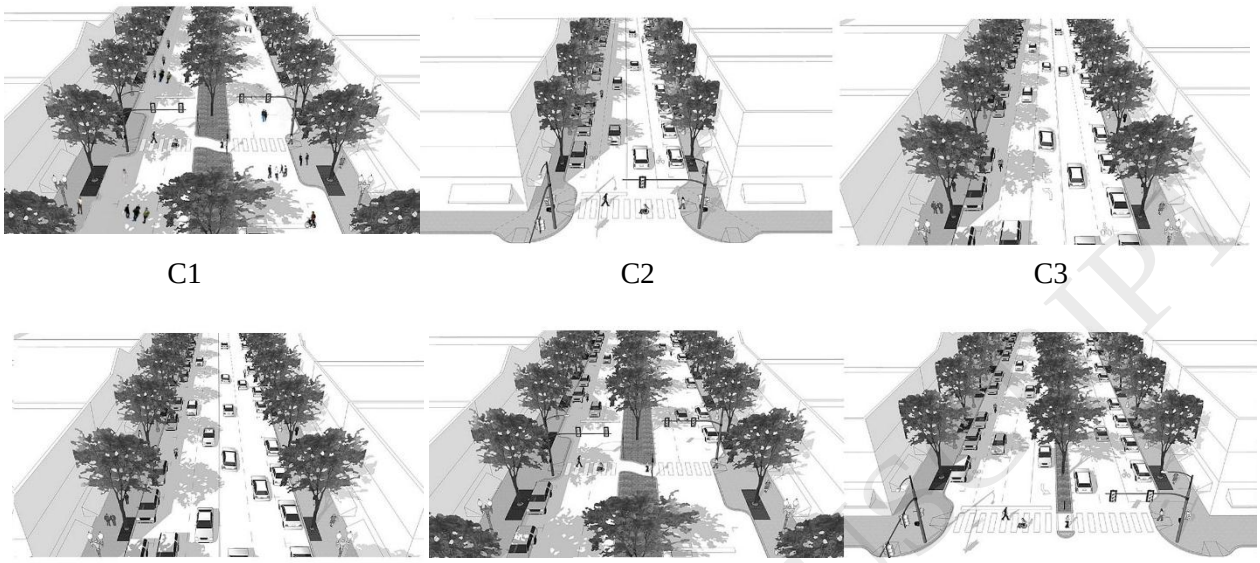


Fig. 3. The sketches showing the different type of street character and scale used in the study (C1: Only pedestrian street; C2: 4-lane street; C3: 5-lane street; C4: 6-lane heavy traffic street; C5: 4-lane boulevard; C6: 6-lane boulevard).

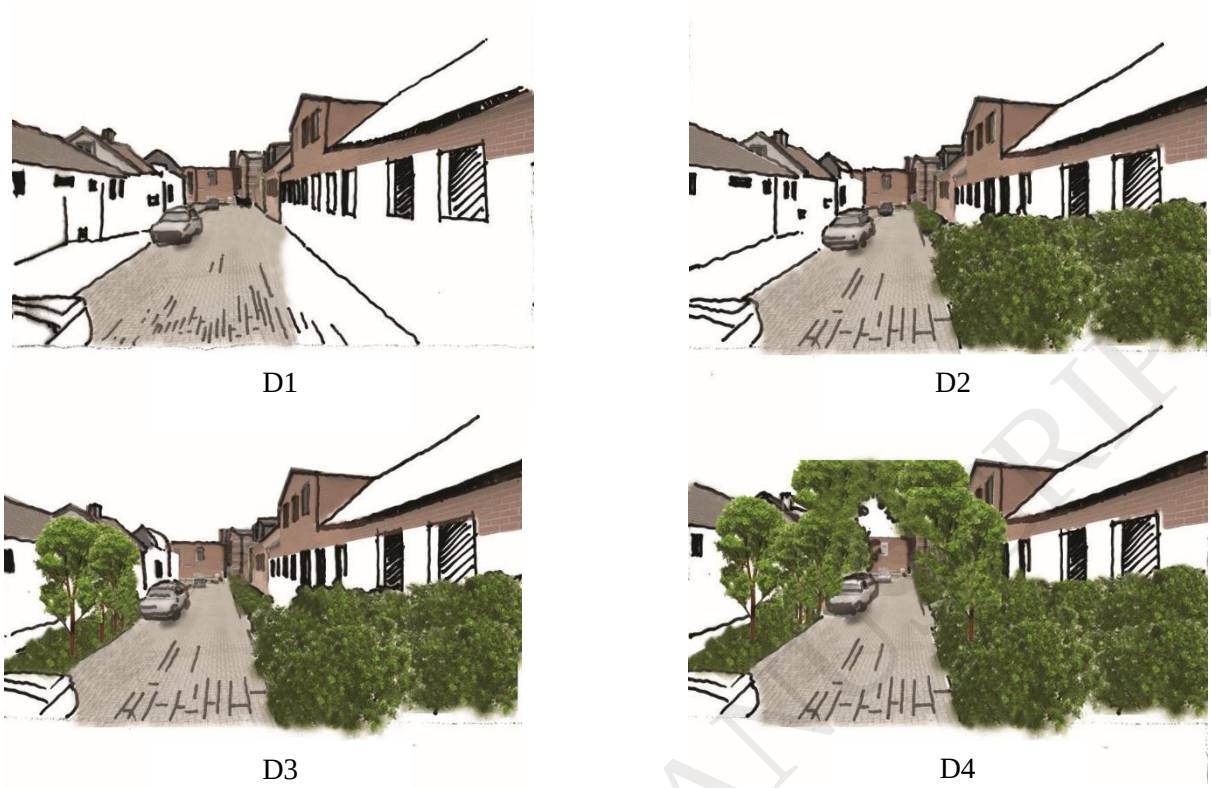


Fig. 4. The sketches showing the different amount of public greenery and vegetation used in the study on environmental preferences (D1- No greenery; D2- 0.01-19.99%; D3- 20.00-39.99%; D4- 40.00% and more).

E1

E2

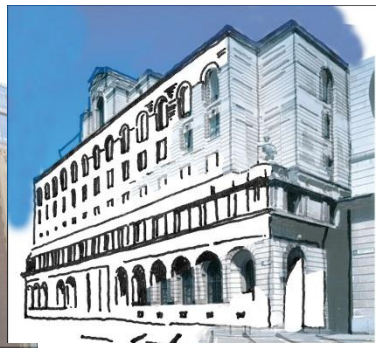
E3

E4

Fig. 5. The sketches showing the different form buildings used in the study on environmental preferences.

F1

F2



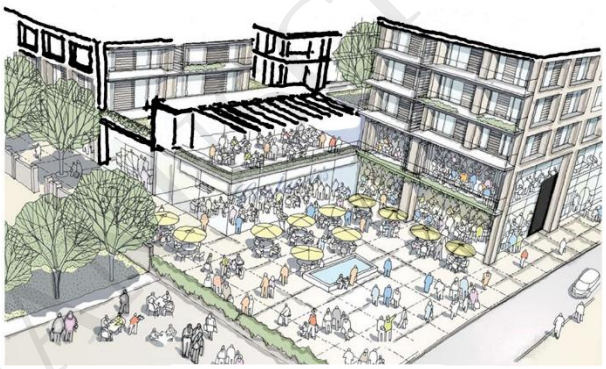
F3

Fig. 6. The sketches showing the contribution of buildings of different periods used in the study on environmental preferences (F1- Only modern buildings; F2- Mixed of modern and traditional buildings; F3- Only traditional buildings).

G1

G2

G3



G4

Fig. 7. The sketches showing the different population density used in the study on environmental preferences (G1- 6 m^2 per occupant; G2- 4.5 m^2 per occupant; G3- 3 m^2 per occupant; G4- 1.5 m^2 per occupant).

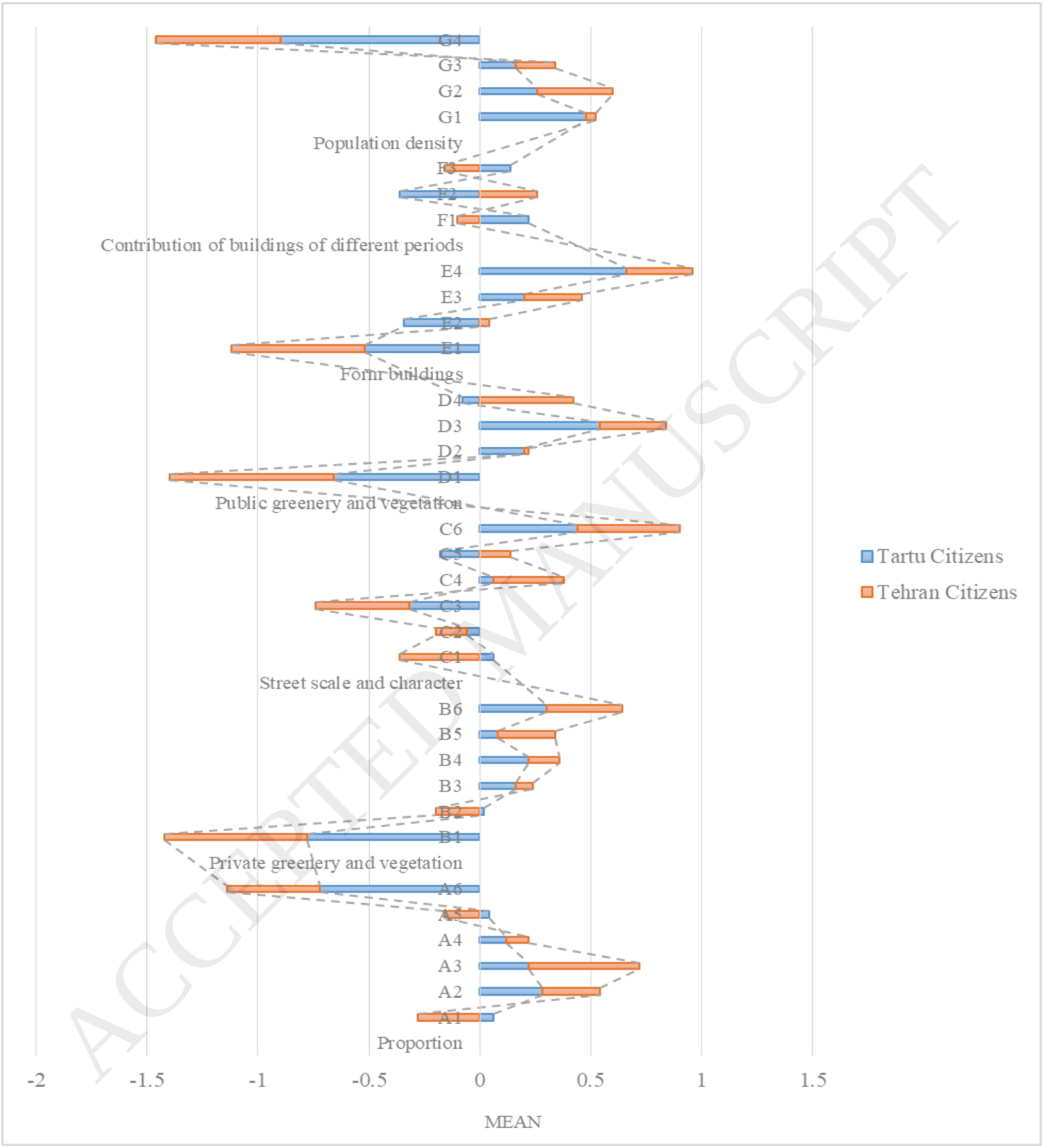


Fig. 8. The mean preference value for each scene be given by two groups of respondents

Table 1: Preference scores given by two groups of respondents in relation to proportion.

	Proportion						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
A1	**102**	**0.06**	**0.652**	**102**	**-0.28**	**0.607**	**915.00**	**-2.596**	**.009**
A2	102	0.28	0.454	102	0.26	0.443	1225.00	-0.224	.823
A3	**102**	**0.22**	**0.545**	**102**	**0.50**	**0.505**	**937.50**	**-2.495**	**.013**
A4	102	0.12	0.328	102	0.10	0.416	1231.00	-0.211	.833
A5	**102**	**0.04**	**0.348**	**102**	**-0.16**	**0.422**	**1017.00**	**-2.521**	**.012**
A6	**102**	**-0.72**	**0.454**	**102**	**-0.42**	**0.499**	**875.00**	**-3.015**	**.003**

Table 2: Preference scores given by two groups of respondents in relation to private greenery and vegetation.

	Private greenery and vegetation						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
B1	102	-0.78	0.418	102	-0.64	0.485	1075.00	-1.535	.125
B2	**102**	**0.02**	**0.141**	**102**	**-0.20**	**0.404**	**980.00**	**-3.432**	**.001**
B3	102	0.16	0.370	102	0.08	0.396	1158.00	-0.997	.319
B4	102	0.22	0.582	102	0.14	0.351	1136.00	-1.028	.304
B5	**102**	**0.08**	**0.274**	**102**	**0.26**	**0.443**	**1025.00**	**-2.384**	**.017**
B6	102	0.30	0.707	102	0.34	0.688	1214.50	-0.268	.789

Table 3: Preference scores given by two groups of respondents in relation to street scale and character.

	Street scale and character						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
C1	**102**	**0.06**	**0.512**	**102**	**-0.36**	**0.485**	**797.00**	**-3.847**	**.000**
C2	102	-0.06	0.512	102	-0.14	0.405	1166.00	-0.802	.422
C3	102	-0.32	0.471	102	-0.42	0.499	1125.00	-1.030	.303
C4	**102**	**0.06**	**0.620**	**102**	**0.32**	**0.587**	**984.50**	**-2.091**	**.037**
C5	**102**	**-0.18**	**0.560**	**102**	**0.14**	**0.351**	**895.50**	**-3.273**	**.001**
C6	102	0.44	0.501	102	0.46	0.503	1225.00	-0.200	.841

Table 4: Preference scores given by two groups of respondents in relation to public greenery and vegetation.

	Public greenery and vegetation						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
D1	102	-0.66	0.479	102	-0.74	0.454	1175.00	-0.645	.519
D2	**102**	**0.20**	**0.404**	**102**	**0.02**	**0.495**	**1030.00**	**-2.101**	**.036**
D3	**102**	**0.54**	**0.503**	**102**	**0.30**	**0.463**	**950.00**	**-2.419**	**.016**
D4	**102**	**-0.08**	**0.778**	**102**	**0.42**	**0.758**	**819.50**	**-3.174**	**.002**

Table 5: Preference scores given by two groups of respondents in relation to form buildings.

	Form buildings						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
E1	102	-0.52	0.505	102	-0.60	0.606	1111.00	-1.114	.265
E2	**102**	**-0.34**	**0.626**	**102**	**0.04**	**0.589**	**878.50**	**-2.903**	**.004**
E3	102	0.20	0.535	102	0.26	0.582	1221.50	-0.234	.815
E4	**102**	**0.66**	**0.479**	**102**	**0.30**	**0.678**	**899.00**	**-2.743**	**.006**

Table 6: Preference scores given by two groups of respondents in relation to contribution of buildings of different periods.

	Contribution of buildings of different periods						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
F1	**102**	**0.22**	**0.910**	**102**	**-0.10**	**0.707**	**972.50**	**-2.031**	**.042**
F2	**102**	**-0.36**	**0.722**	**102**	**0.26**	**0.899**	**772.50**	**-3.514**	**.000**
F3	**102**	**0.14**	**0.700**	**102**	**-0.16**	**0.792**	**981.00**	**-1.983**	**.047**

Table 7: Preference scores given by two groups of respondents in relation to population density.

	Population density						Mann-Whitney U	Z	Sig.
	Tartu Citizens			Tehran Citizens					
	N	Mean	Std. Deviation	N	Mean	Std. Deviation			
G1	**102**	**0.48**	**0.677**	**102**	**0.04**	**0.856**	**899.00**	**-2.622**	**.009**
G2	102	0.26	0.443	102	0.34	0.479	1150.00	-0.868	.385
G3	102	0.16	0.370	102	0.18	0.388	1225.00	-0.265	.791
G4	**102**	**-0.90**	**0.303**	**102**	**-0.56**	**0.675**	**937.50**	**-2.986**	**.003**